# EXECUTIVE SUMMARY

# EVALUATING THE PUBLIC HEALTH OF HAZARDOUS WASTE SITE COMMUNITIES: CURRENT FEDERAL AND STATE POLICIES AND RECOMMENDATIONS FOR THE MIDWAY LANDFILL COMMUNITY

Thomas M. Burbacher, Ph.D.
Research Associate
Department of Environmental Health
School of Public Health
and Community Medicine
University of Washington

In consultation with:

Thomas Vaughan, M.D., M.P.H.
Assistant Professor
Department of Epidemiology
School of Public Health
and Community Medicine
University of Washington

Prepared for:

The City of Seattle
Engineering Department
Solid Waste Division

The community surrounding the Midway Landfill in Kent, Washington has voiced concerns regarding the potential public health problems associated with living near the landfill for many years. These concerns include but are not limited to cancer, reproductive dysfunction, birth defects, respiratory disorders, chronic headaches and nosebleeds, learning disabilities, and memory loss. Public health concerns have intensified during the past two years with the inclusion of the Midway Landfill on the Environmental Protection Agency's National Priority List of Hazardous Waste Sites. In response to the growing concerns of the Midway community, the author of this report was contracted to review the various policies regarding the investigation of public health problems in hazardous waste site communities. The primary purpose of this review was to evaluate procedures that have been used to study these problems, so as to develop recommendations regarding the appropriate options for the Midway Landfill community.

The report is based on information collected (i) from numerous local meetings with health department representatives, citizen groups, and individual residents in the community, (ii) from discussions with representatives from the Environmental Protection Agency, the Centers for Disease Control, the Agency for Toxic Substances and Disease Registry, the Citizen's Clearinghouse for Hazardous Waste and Health Departments in 18 states and (iii) from reviews of over 100 published and unpublished reports from scientific journals, public health groups, and state health department files.

The report includes an overview of the national toxic waste problem, a review of scientific literature related to the evaluation of the public health consequences of hazardous waste sites, a description of Federal, State, and a citizen's group programs for evaluating the health problems of hazardous waste site communities and a list of recommendations for establishing an Environmental Health Evaluation and Education Program to review current procedures and to discuss the appropriate methods for examining the health problems in the Midway Landfill community.

## THE NATIONAL TOXIC WASTE PROBLEM

In 1980, the United States Congress established the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1). This

act created what is commonly known as the Superfund Program under the direction of the Environmental Protection Agency (EPA). The EPA established a National Priority List (NPL) of hazardous waste sites. This list now contains over 700 sites with at least one site in nearly every state in the country (2).

Estimates from the EPA indicate that nearly 2,000 waste sites eventually will require Superfund cleanup (3). Statistics from the Office of Technology Assessment (OTA), however, indicate that the EPA has grossly underestimated the future requirements and that over 10,000 hazardous waste sites will require cleanup (3). The cost of cleaning the estimated 10,000 hazardous waste sites could easily be $100 billion and could take 50 years to accomplish.

## EVALUATING THE PUBLIC HEALTH CONSEQUENCES OF HAZARDOUS WASTE SITES: A REVIEW OF SCIENTIFIC LITERATURE

The requirements for a rigorous Epidemiological evaluation of the human health effects of hazardous waste sites were reviewed in a series of articles published from a 1981 conference on "Research Needs for Evaluation of Health Effects of Toxic Chemical Waste Dumps" (4). An article in this series (5) summarized four principles which should guide the evaluation of persons exposed to hazardous wastes. These principles included (i) the documentation of the nature and extent of the exposure, (ii) the precise definition of the exposed populations, (iii) the specific diagnoses of the disease in the exposed (and control) populations, and (iv) the rigorous evaluation of the relationship between exposure and disease which, if possible, should include the detection of any dose-response relationships.

Other articles have been published in an attempt to provide discussions of the above principles in light of the practical limitations of community health studies associated with hazardous waste sites (6-10). These limitations include exposures that are poorly defined, disease patterns that are not well identified, and a poor understanding of the relationship between other biological factors and illness in man. The articles point out that while the scientific principles associated with defining the health effects of toxic exposures should be utilized in health studies of hazardous waste site communities, these health studies are often part of public service programs that do not meet rigorous scientific standards. These programs, however, fulfill several important practical functions such as providing timely

quantitative information about alleged problems in the community, separating the facts regarding community complaints from rumors, and communicating environmental and public health information to the community to place their fears in proper perspective.

In addition to the above articles, there have been four major reviews of hazardous waste site community health studies published during the past two years (11-14). A summary of the studies included in these reviews is shown in the attached Table. In general, health studies of hazardous waste site communities have repeatedly demonstrated increases in subjective illnesses (e.g., headaches, respiratory distress, nosebleeds, etc.). These results, however, may be influenced by recall bias in the waste site community and do not provide direct evidence of hazardous waste site health effects. In addition, most health studies of hazardous waste site communities have not produced scientific evidence relating serious health effects to hazardous waste sites. Due to limitations in past study designs, sample sizes, and statistical approaches, however, this lack of scientific evidence may also provide an inaccurate assessment of the potential health effects of these sites. As a result, very few general conclusions regarding the health effects of hazardous waste sites can be offered at this time. Reports of increased rates of subjective or nonspecific illness in hazardous waste site communities are considered significant by some, while others stress the limitations of self reported data. The lack of evidence linking hazardous waste sites with serious disorders (e.g., cancer, birth defects) and death may only be relevant for the short term, yet current studies do not provide adequate follow-up data. Although new technologies may assist in the future determination of individual exposures and effects, current methods for identifying exposed members of the community are extremely nonspecific. The only consistent conclusion that has been offered thus far is that there is a critical need for more data concerning the health effects of hazardous waste sites. However, approaches that are being utilized to address this critical need vary as greatly as the current assessment of the waste site situation.

## FEDERAL, STATE AND A CITIZEN'S GROUP PROGRAMS

The 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authorized the EPA to direct the Superfund Program. In

addition, the act called for the creation of a new agency under the Department of Health and Human Services (DHHS) called the Agency for Toxic Substances and Disease Registry (ATSDR). While the EPA was given the major responsibilities regarding hazardous waste site identification, investigation, and cleanup, the ATSDR was given the responsibility to "effectuate and implement the health related authorities of the act" (1). The EPA process includes an assessment of the potential public health impact of each site that is considered for the National Priority List (NPL). The assessment of the potential public health consequences of the hazardous waste site is also an important part of the Superfund Remedial Program (15). The Remedial Program has two phases, the remedial investigation and the feasibility study. The Remedial Investigation/ Feasibility Study (RIFS) can be developed under the direction of the EPA or the state where the hazardous waste site is located. The party responsible for the hazardous waste site can also be involved in developing the RIFS, negotiating with the EPA or the state. EPA policy regarding public participation in this process, according to the Office of Technology Assessment (3), is to exclude the public from all negotiation sessions (regarding the RIFS), but to provide periodic information about the progress of negotiations.

The primary health aspect of the RIFS involves the development of a public health evaluation of the site. Current EPA guidelines, however, do not emphasize aspects of the public health evaluation that would necessitate studies of health problems of the nearby community. Activities related to hazardous waste site communities are usually limited to those included in a public relations program, which focuses on disseminating information regarding the site investigation.

In addition to the public health evaluation, EPA or the state can request the assistance of the ATSDR for health assessments or health studies. According to a memorandum of understanding between ATSDR and EPA (16), the criteria that should be used for requesting assistance from ATSDR includes: "Whether the presence of toxic substances has been confirmed at the site, whether pathways of human exposure to toxic substances have been demonstrated to exist at the site, especially if such pathways involve direct contact with toxic substances, and whether a human population has been exposed to toxic substances via the identified pathways, and whether there exists a threat of current or future health effects to the population being so exposed, after

considering EPA's risk assessments or health effects information from other sources." These criteria require a considerable amount of data concerning the type and extent of contamination from the hazardous waste site, as well as specific data regarding human exposures. The RIFS process provides these data very slowly (sometimes over several years) and in many instances this process does not provide these data at all (because exposures may be transient, episodic, or poorly documented). Formal requests for assistance from ATSDR, therefore, usually do no take place until very late in the RIFS process, after the environmental investigation of the hazardous waste site is complete. Currently, there are no EPA regulations requiring ATSDR or local health experts to participate in developing the RIFS process. Decisions concerning the type and extent of monitoring for possible past and present human exposures to hazardous wastes, therefore, usually take place without direct community or public health representation.

Criteria for performing health studies of hazardous waste site communities or developing Exposure/Outcome Registries of persons exposed to hazardous waste have been proposed by ATSDR and the Center for Environmental Health (CEH), Centers for Disease Control (17-19). One report included a list of criteria for use in assessing the feasibility of health studies of hazardous waste site communities. According to this report, health studies should be considered feasible (i) when biological levels indicating the time period and level of exposure are available or can be obtained; (ii) when the possible effects of the exposure are known, based on human data; (iii) when the health effect is relatively specific or is caused only by the exposures; (iv) when enough people are exposed to allow statistically valid conclusions from the study; and (v) when adequate resources and local cooperation are available. The above criteria regarding health studies and registries were developed, according to an ATSDR Health Study Plan, because so little information exists regarding the effects on humans of long term low level exposure to chemicals or chemical mixtures. These criteria, according to this plan, prioritize those studies that will have the greatest impact for establishing a relationship between chemical exposure and illness. These criteria are rarely met at hazardous waste sites and ATSDR typically does not include studies of health problems of waste site communities in their health evaluation of sites. In addition, these criteria, like those of EPA, do not provide the impetus for early and continued public health input into the site

investigation process (RIFS), even though it is this process that will eventually determine the public health impact of the site on the nearby community. While ATSDR and CDC have conducted or participated in studies at several (NPL) sites, these studies usually were limited to the collection of biological samples for establishing exposure to chemicals and cross-sectional procedures to evaluate health effects. Few follow-up studies have been performed to date, and thus far no registries of persons exposed to hazardous waste from (NPL) sites have been developed by ATSDR.

While the federal programs described above were developed to address health issues at hazardous waste sites, the primary responsibility for responding to questions, requests, and demands of hazardous waste site communities still rests at the state and local health department level. Programs developed by state and local health departments to address community health concerns are of paramount importance then, since these programs will ultimately determine the type and scope of the response.

For this report, information regarding state programs was obtained via three procedures: (i) by reviewing published articles of health studies of hazardous waste site communities; (ii) by reviewing unpublished articles from health department files; and (iii) by a telephone survey of 18 state health departments. The results of the state survey indicate that, while various approaches have been utilized across states, a few general principles can be stated. Nearly all of the health departments surveyed indicated that (i) local community representatives had requested information and/or studies regarding the health problems in a hazardous waste site community; (ii) the state health department typically takes the lead in responding to these requests in order to provide a consistent approach and due to the limited resources at the local level; (iii) in response to these requests, state registries and/or vital statistics records are initially reviewed to investigate serious health problems such as cancer, birth defects, and mortality; and (iv) health studies of hazardous waste site communities are almost always initiated by pressures from the potentially affected community. In addition, for those states that have sponsored large scale community health studies (6 of the 18 states surveyed), the resources for these studies have typically come from funds from State Superfund Programs.

The community health studies sponsored by the states surveyed have used indirect measures of exposure due to the lack of information regarding individual exposures to hazardous wastes. In addition, most studies have relied on self reported symptoms and disease to measure the effects of the hazardous waste site on the community. The results of these studies have indicated that hazardous waste site communities report more and more frequent common symptoms such as respiratory distress, skin rashes and headaches, but do not report increases in serious problems like cancer, birth defects or mortality. Waste site communities have also consistently reported poorer estimates of perceived health than control communities. Only one study, however, attempted to evaluate the influence of "reporting bias" on these symptoms, the remaining studies discussed this problem but did not attempt to address it.

In general, the results of the health studies have not altered the course of action of the hazardous waste site remediation. Most of the studies have concluded that the increased reported symptoms would subside when the problems at the waste site were mitigated. According to these studies, site mitigation would also remedy the problems associated with poor perceived health in the community. No direct investigations to substantiate these conclusions, however, have been performed to date.

Finally, the Citizen's Clearinghouse for Hazardous Wastes has published 2 reports concerning community health studies (20,21). In general, the approach of the Clearinghouse at this time is to advise communities to refrain from demanding a definitive study of the cause of the health problems in their area but to emphasize the need to define the type and extent of health problems as an initial step in the environmental and health investigating process.

## RECOMMENDATIONS FOR MIDWAY HEALTH EVALUATION AND EDUCATION PROGRAM

The results of the review of federal and state programs indicate that there are two basic approaches being used to address the concerns of hazardous waste site communities across the country. One approach, currently being used in federal programs (EPA, ATSDR), typically does not include studies of health problems of the hazardous waste site community. The other approach, currently being used in several state and local programs, includes methods to provide

quantitative information regarding the health problems in the community. The methods currently being used include reviewing state registry and vital statistics records and to a much lesser degree surveying the community regarding more common health problems and symptoms.

The recommendations that are listed below were developed as a result of an assessment of the various options that are available to provide information regarding the health of the Midway Landfill community. The purpose of the recommendations is to develop a Health Evaluation and Education Program that will provide:

(i) a public forum for an ongoing discussion of health related issues in the community as well as general issues related to environmental risk;

(ii) greater public health representation in the decision processes related to environmental monitoring of the site;

(iii) a comprehensive review of available environmental monitoring data from a public health perspective,

(iv) a greater role for the State Department of Social and Health Services (DSHS) in evaluating the environmental monitoring program and establishing a health program for the community, and

(v) a process for the review of procedures that, if implemented, will provide quantitative, reliable data regarding the public health problems in the community to better respond to the needs of the feasibility study and the concerns of the community.

RECOMMENDATION 1. Response to Report: Community and Agency Comments

Prior to implementing the recommendations regarding the Health Evaluation and Education Program, written comments regarding this report should be solicited and incorporated into an appendix for general review. The author has agreed to respond to written comments, if necessary, by amending the report or providing additional information. Written comments should be solicited from representatives of the:

(i) Citizen's Advisory Committee
(ii) Seattle-King County Department of Public Health
(iii) Washington State Department of Social and Health Services
(iv) Washington State Department of Ecology
(v) Environmental Protection Agency
(vi) Agency for Toxic Substances and Disease Registry
(vii) University of Washington's Ad Hoc Committee on Midway Landfill Hazards
(viii) Midway Action Group

The comments of the citizen's advisory committee should represent the views of the committee as well as a summary of the views of the community. The views of the community should be solicited via a public meeting headed by the author of this report and the citizen's advisory committee. Individual citizens should also be encouraged to provide written comments if they desire to do so.

RECOMMENDATION 2. Evaluation of Environmental Data

The University of Washington's Ad Hoc Committee report entitled "Evaluation of Potential Health Effects Associated with Off-Site Gas Extraction Systems at the Midway Landfill" is, thus far, the only document that provides a summary and evaluation of the environmental monitoring data from a public health perspective. This document was developed from very limited data pertaining only to exposure to gaseous emissions from extraction wells.

The Department of Ecology is currently in the process of creating a data base management system for all of the environmental monitoring data that have been collected since the Superfund investigation of the Midway Landfill began. This data base should be supplemented with any environmental monitoring data that was collected prior to this investigation, especially during the period that the landfill was in operation. The entire data base, then, should be reviewed in a manner similar to the University's Ad Hoc Committee report, although discussion of noncarcinogenic effects (reproductive, neurotoxic) including issues related to the reporting of an exacerbation of numerous common symptoms should be included.

RECOMMENDATION 3. Remedial Investigation/Feasibility Study (RIFS) Evaluation

The current RIFS plan was developed primarily through negotiations between the Department of Ecology and the City of Seattle. While the Environmental Protection Agency must review and approve the RIFS plan, no such review is required by health experts or any health agency. A review of the RIFS plan to determine whether the current site investigation will provide adequate information for a comprehensive evaluation of the health risks to the surrounding community is recommended. This review should be part of the Environmental Data Evaluation Report (see recommendation 2), since previous environmental monitoring data will influence the requirements of the current RIFS. The development of this report should be supported by the Department of Ecology.

Finally, a representative from DSHS should be included in future negotiations regarding the site investigation and should report on the progress of the site investigation to the Health Evaluation and Education Work Group.

RECOMMENDATION 4. Formation of a Health Evaluation and Education Work Group

While numerous committees have been established to discuss issues related to the remedial investigation, a format has yet to be established that would provide an adequate ongoing discussion of the health concerns of the community. It is recommended, therefore, that a community Health Evaluation and Education Work Group be established to provide a continuous format for the discussion of health related issues. This work group should include representatives of the Midway Landfill community (including health providers who live in or serve the community) and the City of Seattle, the Seattle-King County Health Department, the Department of Ecology, DSHS and local EPA and CDC representatives. The meetings of the Work Group should be co-chaired by a representative of the Midway community and a representative from DSHS and should be open to all interested Midway Landfill residents. The work group should:

(i) discuss the current EPA and ATSDR criteria for evaluating the health effects of hazardous waste sites;

(ii) discuss the current ATSDR criteria for performing health studies of hazardous waste site communities (see page 5);

(iii) discuss the ongoing negotiations, procedures and results regarding the site investigation;

(iv) prioritize the health evaluation tasks listed below or proposed by others;

(v) evaluate the appropriate administrative procedures for implementing health evaluation tasks (e.g., internal agency health experts vs external consultants or contractors);

(vi) evaluate proposals for implementing health evaluation tasks;

(vii) recommend health evaluation scientists to implement the tasks;

(viii) provide ongoing oversight of the implementation of health evaluation tasks;

(ix) evaluate the results of health evaluation tasks; and

(x) disseminate information regarding the objectives, procedures and results of health evaluation tasks to the Midway community.

## SOME HEALTH EVALUATION TASKS FOR CONSIDERATION BY THE HEALTH EVALUATION AND EDUCATION WORK GROUP

The following health evaluation tasks are provided for discussion by the work group. These tasks are included because they represent the most common procedures that have been used by other health officials to provide quantitative information regarding the health problems of concern to the community. Other tasks should be considered by the Work Group, as well as factors that influence the likelihood that these tasks can be implemented (e.g., funding source, availability of health experts), a task beyond the scope of this report.

### TASK 1. Cancer Study: Census Blocks

The Fred Hutchinson Cancer Research Center's Cancer Surveillance System (CSS) has been in place since 1974. With cooperation from the 58 area hospitals, as well as private pathology laboratories, the CSS identifies over

99% of incident cancers occurring in the 13 counties of western Washington. This information is coded to the census tract (CT) level. Some previous studies have reported cancer rates for census tracts adjacent to waste sites, while others have coded cancers to the census block level. Census blocks (CB's) are subdivisions of census tracts defined in such a way as to try to keep the number of people in each block approximately the same: in urban areas, they are basically one city block, in less dense areas they are correspondingly bigger. In the absence of any detailed environmental information, all CB's making up the "affected area" around the landfill (based on the best available data) could become the exposed group, and all other CB's within the adjacent census tracts or King County as a whole could make up a comparison group. As additional environmental data become available, each CB could be assigned a simple (2 or 3 level) code for each "exposure" (e.g. CB-1 might be high-exposed for migrating methane, but low-exposed for a different contaminant). Cancer rates (or any available medical event data having been coded to the appropriate CB) could then be reanalyzed for associations with each exposure type. This study could be done in a relatively short period of time (approximately 4 months) and would provide specific information regarding cancer rates in the Midway community. Due to the small size of the population in the study, however, individual cancers would have to be increased 3 to 6 fold to detect a difference in an "exposed" group. Increases of this magnitude are rarely observed in studies of environmental exposures. In addition, this study will not provide information regarding the risk of current residents developing cancer in the future. These limitations should be discussed by the work group so that all participants are aware of how to interpret the results of this study.

TASK 2. Birth Certificate Study: Census Blocks

Birth certificate data are also available with pre-coded census tract information. The 1984 and 1985 data have check-boxes for congenital malformations which seem to improve the reporting of them (at least those identified in the first several days of birth). These data could be analyzed in much the same way as the cancer data: coded down to the census block level, assigned exposures based on best available information, and compared to the experience of King County as a whole. In addition, other adverse

outcomes of interest, such as low birthweight, low Apgar scores, and previous spontaneous abortions could also be examined using birth certificate data. Again, this study could be performed in a relatively short period of time (approximately 6 months) and would provide specific information regarding congenital malformations and other adverse outcomes in the Midway community. Limitations in the ability to detect a difference in an "exposed" group, however, would be even greater than those of the cancer study. These limitations should be discussed in detail by the work group.

TASK 3. Community Health Survey: Current Population/Census Blocks

While the results of the cancer registry and birth certificate studies provide important information regarding these health outcomes, the health problems that are usually reported by hazardous waste site communities are typically examined via a health survey. Previous surveys have utilized face-to-face or telephone interviews of a family member to collect health information regarding the entire family. Other studies have relied on self-administered surveys of all family members. The majority of these surveys have attempted to compare all families within the potentially affected area with families in a separate control area. Due to the numerous problems inherent in survey research, however, the results of these studies are generally not considered reliable indicators of the type and extent of health problems in the community. Therefore, the health survey, if implemented, should be considered only the first phase of an investigation regarding the prevalence of common diseases and illnesses in the community. Depending on the outcome of the survey (i.e., which diseases are reportedly increased), follow-up studies to validate certain conditions by review of medical records or physician examinations or possibly a case control study should be considered. Finally, procedures to minimize and estimate the influence of recall bias should be considered important components of any health survey procedure.

TASK: 4. Midway/Parkside School Study: Current Population

Many of the health problems reported by Midway residents have been observed in children who live in the area. Several residents have requested

that children from the Parkside and Midway schools be studied, since children from inside and outside the Midway community are now attending these schools. Particular concern for young children (grades 1-3) that are now being bused from outside the Midway area to Parkside school has been expressed. Procedures for studying the health problems of children from the Parkside and Midway school would not involve extensive resources in addition to the health survey (Task 3). Parents of children attending the Parkside and Midway schools, who do not live in the Midway area, could easily be identified from school records and included in the health survey.

## REFERENCES


(1) United States Congress. Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

(2) United States Environmental Protection Agency, Office of Emergency and Remedial Response. Amendment to National Oil and Hazardous Substances Contingency Plan: National Priorities List; Final Rule and Proposed Rules; Federal Register, 51(111), 21054-21098, 1986.

(3) United States Congress, Office of Technology Assessment. Superfund Strategy. OTA-ITE-252, 1985.

(4) National Institute of Environmental Health Sciences, University-Based Centers for Environmental Health Sciences. Research Needs for Evaluation of Health Effects of Toxic Chemcial Waste Dumps. Research Triangle Park, North Carolina, October 27-28, 1981.

(5) Landrigan, P.J. Epidemiologic Approaches to Persons with Exposures to Waste Chemicals. Environmental Health Perspectives, 48, 93-97, 1983.

(6) Heath, C.W. Field Epidemiologic Studies of Populations Exposed to Waste Dumps. Environmental Health Perspectives, 48, 3-7, 1983.

(7) Neutra, R.R. Roles for Epidemiology: The Impact of Environmental Chemicals. Environmental Health Perspectives, 48, 99-104, 1983.

(8) Selikoff, I.J. Clinical and Epidemiological Evaluation of Health Effects in Potentially Affected Populations. Environmental Health Perspectives, 48, 105-106, 1983.

(9) Anderson, H.A. Evolution of Environmental Epidemiologic Risk Assessment. Environmental Health Perspectives, 62, 389-392, 1985.

(10) Neutra, R.R. Epidemiology for and with a Distrustful Community. Environmental Health Perspectives, 62, 393-397, 1985.

(11) Buffler, P.A., Crane, M., Key, M.M. Possibilities of Detecting Health Effects by Studies of Populations Exposed to Chemicals from Waste Disposal Sites. Environmental Health Perspectives, 62, 423-456, 1985.

(12) Levine, R., Chitwood, D.D. Public Health Investigations of Hazardous Organic Chemical Waste Disposal in the United States. Environmental Health Perspectives, 62, 415-422, 1985.

(13) Phillips, A.M., Silbergeld, E.K. Health Effects Studies of Exposure from Hazardous Waste Sites - Where Are We Today? American Journal of Industrial Medicine, 8, 1-7, 1985.

(14) University Association for Research and Education in Pathology. Health Aspects of the Disposal of Waste Chemicals. Grisham, J.W. (Ed.), Pergamon Press, New York, 1986.

(15) United States Environmental Protection Agency, Office of Emergency and Remedial Response. The Superfund Remedial Program. WH/FS-86-002, 1986.

(16) Memorandum of Understanding Between the Agency for Toxic Substances and Disease Registry and the United States Environmental Protection Agency. Internal Document, Centers for Disease Control, Atlanta, Georgia 30333, 1985.

(17) United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. Agency for Toxic Substances and Disease Registry Health Study Plan. Internal Document, Agency for Toxic Substances and Disease Registry, 1984.

(18) United States Department of Health and Human Services, Centers for Disease Control. A System for Prevention, Assessment, and Control of Exposures and Health Effects from Hazardous Sites. Manual developed for Center for Environmental Health, Chronic Diseases Division, Centers for Disease Control, Atlanta, Georgia 30333, 1984.

(19) United States Department of Health and Human Services, Centers for Disease Control. Report of the Subcommittee on Environmental Registries, Department of Health and Human Services Committee to Coordinate Environmental and Related Programs: Criteria for Environmental Public Health Problems. Prepared for the Agency for Toxic Substances and Disease Registry by Center for Environmental Health, Centers for Disease Control, Atlanta, Georgia 30333, 1984.

(20) Citizen's Clearinghouse for Hazardous Wastes, Inc. Will a Community Health Survey Work For You? Publication #10, Citizen's Clearinghouse for Hazardous Wastes, INC., Post Office Box 926, Arlington VA 22216.

(21) Citizen's Clearinghouse for Hazardous Wastes, INC. Center for Disease Control: Cover-Up, Deceit and Confusion. Publication #31, Citizen's Clearinghouse for Hazardous Wastes, Inc., Post Office Box 926, Arlington, VA 22216.

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES

| SITE | NPL# | EXPOSURES | RESULTS |
|---|---|---|---|
| Triana/Tennessee River, AL | 31 | Serum DDT levels in exposed residents | Altered lipid & liver metabolism |
| Tucson International Airport Area, AZ | 70 | Exposed & control areas TCE in well water | ↑ School absenteeism, no ↑ defects & mortality |
| Mountain View Mobile Home Estates, AZ | 94 | Asbestos in air, soil & dust of exposed residents | No current asbestos related diseases |
| Vertac Inc., AR | 18 | Urine levels of 11 chemicals related to herbicide exposure in exposed & control children | No health problems studied |
| Stringfellow, CA | 32 | Exposed & control areas Multiple contaminants | ↑ Earache, nausea, headache, skin rash, sinus blockage, dizziness |
| Operating Industries, CA | 71 | Exposed & control areas Multiple contaminants | ↑ Headache, nausea, eye & skin irritation, tiredness; no ↑ death, cancer, pregnancy problems |
| Purity Oil, CA | 280 | NR | NR |
| McColl, CA | 335 | Exposed odor areas & control area, Multiple petroleum contaminants | ↑ Headache, nervousness & other "bothersome" symptoms |
| Fairchild Camera & Instrument Corp., CA | P | Exposed & control areas TCE & DCE in well water | ↑ Spontaneous abortions & birth defects |
| Del Amo, CA | NL | Exposed & control areas Multiple contaminants | NR |
| BKK Landfill, CA | NL | Exposed & control areas Multiple contaminants | No ↑ skin rashes & cancer |

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

| SITE | NPL# | EXPOSURES | RESULTS |
|---|---|---|---|
| Bunker Hill Mining & Mettallurg Complex, ID | 106 | Blood lead levels in exposed children | ↑ Lead toxicity (BL≥25 µg/dl & EP ≥35 µg/dl), anemia; ↓ nerve conduction velocity |
| Neal's Landfill (Bloomington), IN | 290 | Serum PCB levels in exposed & control residents | Altered lipid metabolism |
| Calcasieu Parish, LA | NL | Exposed & control areas Multiple contaminants | ↑ Eye, respiratory & other reported symptoms associated with "reporting bias" |
| New Bedford Site, MA | 80 | Serum PCB levels in exposed residents | No health problems studied |
| Silresim Chemical Corp., MA | 293 | Exposed & control areas Multiple contaminants | ↑ Respiratory symptoms, headache, fatigue, heart problems |
| Wells G&H (Woburn), MA | 294 | Water usage in residents with Pb, As, TCE in well water | ↑ Leukemia, perinatal mortality, birth defects, childhood sickness |
| McKin CO., ME | 33 | Residents exposed to TCE in well water | NR |
| E.I. Du Pont De Nemours & CO., INC. (Montague Plant), MI | P | Residents exposed to multiple contaminants in well water & fish | NR |
| "PCB Site in Mich.", MI | NL | Serum PCB levels in exposed & control residents | Altered immune function, no skin, liver problems |
| St. Regis Paper CO., MN | 133 | NR | NR |
| Perham Arsenic Site, MN | 411 | Hair arsenic levels in exposed residents | Neuropathy & intestinal disorders |

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

| SITE | NPL# | EXPOSURES | RESULTS |
|---|---|---|---|
| Times Beach/Shenandoah Stables, MO | 366<br>663 | Exposed & control areas 2,3,7,8-TCDD sprayed on soil | Altered liver & immume function tests |
| Lipari Landfill, NJ | 1 | Exposed & control areas<br>Multiple contaminants | NR |
| Price Landfill, NJ | 6 | Exposed & control areas<br>Multiple contaminants<br>in well water | ↑ Eye irritation, rash, tiredness, muscle pain, nausea, pregnancy problems |
| "GEMS" Landfill, NJ | 12 | Exposed & control areas<br>Multiple contaminants | ↑ Respiratory symptoms, nosebleeds, headaches, nausea, no ↑ reproductive, pulmonary effects |
| Krysowaty Farm, NJ | 103 | Exposed & control areas<br>Multiple contaminants<br>in well water | ↑ Tiredness for women, no ↑ numerous other reported symptoms |
| Universal Oil Prod. (Chem. Div.), NJ | 108 | Exposed & control children<br>Benzene, TCE | ↑ Leukemia & Hodgkins disease |
| Reich's Farms, NJ | 122 | Residents exposed to multiple contaminants in well water | No association between illness & well water use |
| Jackson Township Landfill, NJ | 407 | Residents exposed to multiple contaminants in well water | ↑ Skin, kidney problems, hospitalization; no ↑ reproductive problems |
| Pomona Oaks Residential Wells, NJ | 600 | Residents exposed to Benzene & Volatile Organics | ↑ Cancer risk through inhalation of contaminated shower water |
| Sussex County Municipal Utility Authority, NJ | NL | Exposed & control areas<br>multiple petroleum contaminants | ↑ Headaches, sore throats, eye irrition, altered immune system, no ↑ olfactory loss |

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

| SITE | NPL# | EXPOSURES | RESULTS |
|---|---|---|---|
| GE Moreau "Caputo", NY | 52 | NR | NR |
| Love Canal, NY | 139 | Exposed & control areas multiple contaminants | ↑ Spontaneous abortions, LBW infants; no ↑ leukemia, cancer, chromosome aberrations |
| Hooker (Hyde Park), NY | 510 | Blood pesticide levels in exposed residents | ↑ Gastrointestinal symptoms, cough, benign tumors |
| Brookfield Avenue Landfill, NY | NL | Exposed & control areas Multiple contaminants | ↑ Cough, headache, nausea, URI, sinusitus, medication; no ↑ doctor visits, hospitalization |
| Woodstock, NY | NL | Residents exposed to asbestos in drinking water | NR |
| Drake Chemical, PA | 394 | Exposed & control areas Multiple contaminants | ↑ Cancer, skin problems, sleepiness; no ↑ birth defects, numerous reported symptoms |
| Wade (ABM), PA | 452 | Residents exposed to Multiple contaminants | No ↑ neurologic, hematologic, liver abnormalities |
| Old City of York Landfill, PA | 540 | NR | NR |
| Stanley Kessler, PA | 544 | Urine levels of TCE metabolites in exposed residents | No acute illness reported |
| North Hollywood Dump, TN | 95 | Exposed & control areas Multiple contaminants | ↑ Heart murmur, cough, urinary infection, mental illness, arthritis, digitalis medication; no ↑ numerous other symptoms |

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

| SITE | NPL# | EXPOSURES | RESULTS |
|---|---|---|---|
| Velsicol Chem. (Hardeman County), TN | 200 | Exposed & control residents Multiple contaminants in well water | ↑ Altered liver function; No ↑ altered renal funtion, skin or eye problems |
| "Lead Smelter in Texas", TX | NL | Blood lead levels in Exposed & control children | ↓ Motor response, intelligence scores |
| "Arsenic Site", VA | NL | Urine arsenic levels in exposed residents | Gastroenteritis, Encephalopathy, Nephropathy, Hepatitis |
| Commencement Bay, Near Shore/Tide Flats, WA | 329 | Urine arsenic levels in exposed residents | No ↑ absenteeism, hearing loss, birth defects, low birthweight infants |
| Kanawha County, WV | NL | Exposed & control areas vinyl chloride monomer | ↑ Central nervous system malformations in newborns |
| "Phenol Spill", WI | NL | Exposed & control areas Phenols in well water | ↑ diarrhea, mouth sores, burning mouth; no ↑ symptoms after 6 months |